SECTION 826 STRUCTURAL STEEL

826.01 Description. This material consists of structural steel, fasteners, bearings, and related materials fabricated, painted, and inspected in a shop environment. Related field activities such as erection and field painting are specified in Section 605. Requirements for working drawings are specified in Subsection 105.04.

MATERIAL REQUIREMENTS.

826.02 Structural Steel. Materials shall be stored in accordance with Subsection 605.03.

Structural steel for bolted and welded steel structures shall be furnished according to the following specifications unless otherwise specified:

a. Structural carbon steel for bolted or welded construction conforming to AASHTO M 183/M 183M shall be furnished.

b. Steel for eyebars shall be of weldable grade. These grades include:

1. Structural steel conforming to AASHTO M 183/M 183M,

2. Structural steel conforming to AASHTO M 222/M 222M,

3. High-strength low-alloy structural manganese vanadium steel conforming to AASHTO M 223/M 223M, and

4. High-strength low-alloy structural steel conforming to AASHTO M 270/M 270M.

c. High-strength low-alloy structural steel shall conform to:

1. AASHTO M 222/M 222M, or

2. AASHTO M 223/M 223M, or

3. AASHTO M 244/M 244M.

d. High-strength low-alloy structural steel for welding shall conform to:

1. AASHTO M 223/M 223M, Grades 42 and 50 (Grades 290 and 345). Structural shapes shall be limited to Groups 1, 2, and 3 of AASHTO M 160/M 160M. Plates and bars of Grade 42 (Grade 290) shall be limited to thicknesses through 40 (100 mm). Plates and bars of Grade 50 (Grade 345) shall be limited to thicknesses through 120 (38 mm).

2. AASHTO M 222/M 222M. The following supplemental requirements for impact properties shall be met:

    a. *Impact Tests.* The Contractor shall provide the heat qualification results for one impact test from the thickest material and one impact test for the thinnest material for each heat and product furnished. The impact test shall be the longitudinal Charpy V-Notch (CVN) test conforming to the requirements of AASHTO T 244. Products are defined as plates, shapes, and bars. If less than 50 tons (45 metric tons) of a product are supplied using a

given heat, only one impact test for the thickest material is required for that heat.

For a heat to qualify, the average energy absorbed at 40 ºF (4 ºC) on the test specimens shall not be less than 15 foot pounds (20 J), except when sub-size specimens are required. The minimum average energy absorption for sub-size test specimens shall be as follows:

Size	*Energy Absorption*
10 by 7.5 mm	12 ft**$**lb (16 J)
10 by 5 mm	8 ft**$**lb (11 J)

One impact test consists of the average value of three adjacent specimens. The results for a single specimen may be below the above specified minimum values, but in no case below two-thirds of the value. If more than one value is below the specified minimum, or if one specimen is below two-thirds of the specified minimum, a retest of three additional specimens shall be made. Each retest must equal or exceed the specified minimum. If the thickest or thinnest material tested fails to qualify, the thickness or those thicknesses shall be rejected. However, the next thinner or thicker material to be furnished may be tested. If the retest results meet the requirements, the heat will be considered qualified for those thicknesses represented by the retest.

The governing thickness for beams, tees, and channels shall be the average flange thickness. The governing thickness for angles shall be the specified leg thickness. Test specimens for these sections shall be taken at a point one-third the distance from the outer edge of the flange or leg to the web or heel of the section.

ents for Notch Toughness. Requirements are provided herein for notch toughness of the steel. These are mandatory for material designated as main load carrying member components subject to tensile stress.

supplied shall meet the longitudinal CVN tests specified in Table 826-A. Sampling and testing procedures shall be in accordance with AASHTO T 243/T 243M.

Table 826-A

Charpy V-Notch Test Requirements

Steel Designation	*Thickness*	*Equivalent Absorbed Energy*	*Frequency of Testing*
AASHTO M 183/M 183M	Up to 40 (100 mm)	15 ft**$**lb @40 ºF (20 J @ 4 ºC)	H**
AASHTO M 222/M 222M	Up to 20 (50 mm), welded	15 ft**$**lb @ 40 ºF (20 J @ 4 ºC)	H
	over 2 to 40 (51 to 100 mm), welded	20 ft**$**lb @ 40 ºF (27 J @ 4 ºC)	

	Up to 40 (100 mm), mechanically fastened	15 ft$lb @ 40 ºF (20 J @ 4ºC)	
AASHTO M 223/M 223M*	Up to 20 (50 mm), welded	15 ft$lb @ 40 ºF (20 J @ 4 ºC)	H
	Up to 40 (100 mm), mechanically fastened	15 ft$lb @ 40 ºF (20 J @ 4 ºC)	
AASHTO M 244/M 244M	Up to 220 (64 mm), welded	25 ft$lb @ 0 ºF (34 J @ -18 ºC)	P***
	22 to 40 (65 to 100 mm), welded	35 ft$lb @ 0 ºF (47 J @ -18 ºC)	
	Up to 40 (100 mm), mechanically fastened	25 ft$lb @ 0 ºF (34 J @ -18 ºC)	

* If the yield point of the material exceeds 65 ksi (450 MPa), the temperature for the CVN value for acceptability shall be reduced by 15 ºF (8 ºC) for each increment of 10 ksi (70 MPa) above 65 ksi (450 MPa).

** "H" (Heat Testing)

*** "P" (Piece Testing)

The materials subject to the notch toughness requirements are the main load carrying components under tensile stress. The main load carrying member components are the flanges, webs, and splice plates of the steel girders.

e. High-strength structural steel for bolted construction shall conform to:

1. AASHTO M 222/M 222M, or
2. AASHTO M 223/M 223M, or
3. AASHTO M 244/M 244M.

826.03 Fasteners. The Contractor shall provide a supplier's certification for all bolts, nuts, and washers. This certification shall include origin of all materials, result of the rotational-capacity tests, date and location of tests, and zinc thickness on galvanized fasteners. Lot numbers of fasteners shall be listed on the certificate and the shipping papers.

Bolts, nuts, and circular washers shall conform to the requirements of AASHTO M 164 (M 164M), Type 1 including suitable nuts and plain hardened washers. Bolts manufactured to AASHTO M 164M are marked on the top of the head with three radial lines and the symbol **A325 (A 325M)**. Nuts are marked on one face with three similar circumferential markings, 120 degrees apart, or alternatively, with **C**, **2**, **D**, **2H**, or **DH**. Bolt and

nut dimensions shall conform to Table 826-B for heavy hexagon structural bolts and for heavy semi-finished nuts, except as allowed in the following paragraph.

Bolts	*Nuts*
A 325 (A 325M) A 490 (A 490M)	ASTM A 563 (A 563M)

When specified on the Plans, or at the option of the Contractor, bolts, nuts, and circular washers conforming to the requirements of AASHTO M 253 (M 253M), Type 1, quenched and tempered shall be used. Alloy steel bolts for structural steel joints shall be furnished.

Subject to the approval of the Engineer, other fasteners which meet the chemical composition requirements of AASHTO M 164 (M 164M) and which meet the mechanical requirements of the same specifications in full-size tests, and which have body diameter and bearing areas under the head and nut, or their equivalent, not less than those provided by a bolt and nut of these same nominal dimensions referenced in Table 826-B, may be used. Such alternate fasteners may differ in other dimensions from those specified for AASHTO M 164 (M 164M) bolts and nuts.

Table 826-B

Bolt and Nut Dimensions - US Customary Unit

Nominal Bolt Size (D)	*Bolt Dimensions, in Inches Heavy Hexagon Structural Bolts*			*Nut Dimensions, In Inches Heavy-Semi-Finished Hexagon Nuts*	
	Width Across Flats (F)	*Height (H)*	*Thread Length (T)*	*Width Across Flats (W)*	*Height (H)*
1/2	7/8	5/16	1	7/8	31/64
5/8	1-1/16	25/64	1-1/4	1-1/16	39/64
3/4	1-1/4	15/32	1-3/8	1-1/4	47/64
7/8	1-7/16	35/64	1-1/2	1-7/16	55/64
1	1-5/8	39/64	1-3/4	1-5/8	63/64
1-1/8	1-13/16	11/16	2	1-13/16	1-7/64
1-1/4	2	25/32	2	2	1-7/32
1-3/8	2-3/16	27/32	2-1/4	2-3/16	1-11/32
1-1/2	2-3/8	15/16	2-1/4	2-3/8	1-15/32

Table 826-B

Bolt and Nut Dimensions - Metric Units

Nominal Bolt Size (D)	*Heavy Hexagon Structural Bolt Dimensions (mm)*	*Nut Dimensions (mm)*

	Width Across Flats (F)	*Height (H)*	*Thread Length (T)*	*Width Across Flats (W)*	*Height (H)*
13	22	8	25	22	12
16	27	10	32	27	15
19	32	12	35	32	19
22	36	14	38	36	22
25	41	15	44	41	25
28	46	17	50	46	28
32	50	20	50	50	31
35	55	21	57	55	34
38	60	24	57	60	37

Circular washers shall be flat and smooth and their nominal dimensions shall conform to dimensions referenced in Table 826-C.

Beveled washers for American Standard Beams and Channels shall be square or rectangular, shall taper in thickness, and shall conform to the dimensions given in Table 826-C.

Where necessary, washers may be clipped on one side to a point not closer than seven-eighths of the bolt diameter from the center of the washer.

Table 826-C

Washer Dimensions [a] - US Customary Units

Circular Washers					*Square or Rectangular Beveled Washers for American Standard Beams and Channels*		
Bolt Size (D)	*Nominal Outside Diameter [b]*	*Nominal Diameter of Hole*	*Thickness*		*Minimum Side Dimension*	*Mean Thickness*	*Slope of Taper in Thickness*
			Minimum	*Maximum*			
1/2	1-1/16	17/32	.097	.177	1-3/4	5/16	1:6
5/8	1-5/16	21/32	.122	.177	1-3/4	5/16	1:6
3/4	1-15/32	13/16	.122	.177	1-3/4	5/16	1:6
7/8	1-3/4	15/16	.136	.177	1-3/4	5/16	1:6
1	2	1-1/16	.136	.177	1-3/4	5/16	1:6
1-1/8	2-1/4	1-1/4	.136	.177	2-1/4	5/16	1:6
1-1/4	2-1/2	1-3/8	.136	.177	2-1/4	5/16	1:6
1-3/8	2-3/4	1-1/2	.136	.177	2-1/4	5/16	1:6

1-1/2	3	1-5/8	.136	.177	2-1/4	5/16	1:6
1-3/4	3-3/8	1-7/8	.178[c]	.28[c]	---	---	---
2	3-3/4	2-1/8	.178	.28	---	---	---
Over 2 to 4 inc.	2D-1/2	D+1/8	.24 [d]	.34 [d]	---	---	---

[a] Dimensions in inches

[b] May be exceeded by 1/4 in.

[c] 3/16 in. nominal

[d] 1/4 in. nominal

Table 826-C

Washer Dimensions [a] - Metric Units

Circular Washers					*Square or Rectangular Beveled Washers for American Standard Beams*		
Nominal Bolt Size (D)	*Nominal Outside Diameter [b]*	*Nominal Diameter of Hole*	*Thickness*		*Minimum Side Dimension*	*Mean Thickness*	*Slope of Tape*
			Minimum	*Maximum*			
13	27	13	3	5	44	8	1:6
16	33	17	3	5	44	8	1:6
19	37	21	3	5	44	8	1:6
22	44	24	4	5	44	8	1:6
25	50	27	4	5	44	8	1:6
28	57	32	4	5	57	8	1:6
32	63	35	4	5	57	8	1:6
35	69	38	4	5	57	8	1:6
38	75	41	4	5	57	8	1:6
44	85	47	5 [c]	7 [c]	---	---	---
50	94	53	5	7	---	---	---
51 to 100	2D-13	D-3	6 [d]	9 [d]	---	---	---

[a] millimeters

[b] May be exceeded by 6 mm

[c] 5 mm nominal

[d] 6 mm nominal

Unless otherwise specified on the Plans, all high-strength bolts, nuts, and washers shall be mechanically galvanized in accordance with AASHTO M 298. Coating thickness, adherence, and quality requirements, however, shall conform to Class C of AASHTO M 232. Type 3, AASHTO M 164 (M 164M) and AASHTO M 253 (M 253M), bolts, nuts, and washers specified for use with unpainted, AASHTO M 270/M 270M, GRADE 345W connections shall not be galvanized. Ungalvanized AASHTO M 253 (M 253M) bolts and hardware will

not be used for hot-dipped galvanized connections. In addition, hot-dip galvanizing of Type 3, AASHTO M 164 (M 164M) or AASHTO M 253 (M 253M), bolts will not be permitted.

826.04 Shear Connectors. Shear connector studs shall conform to the requirements of AASHTO M 169 for cold-finish carbon steel bars and shafting, and cold-drawn bars, Grades 1015, 1018, or 1020, either semi-kilned or fully-kilned. If flux-retaining caps are used, the steel for the caps shall be of a low-carbon grade suitable for welding and shall comply with ASTM A 109 (A 109M) for cold-rolled, carbon-steel strip.

Tensile properties as determined by tests of bar stock after drawing or of finished studs shall conform to the following requirements:

Tensile strength (minimum)	60 ksi (415 MPa)
Yield strength * (minimum)	50 ksi (345 MPa)
Elongation (minimum)	20 (50 mm)
Reduction in area (minimum)	50%

* As determined by a 0.2% offset method

Tensile properties shall be determined according to the applicable sections of AASHTO T 244 for mechanical testing of steel products. Tensile tests of finished studs shall be made on studs similar to those shown in Table 826-D.

If fracture occurs outside the middle half of the gage lengths, the test shall be repeated.

Finished studs shall be of uniform quality and condition, free from injurious laps, fins, seams, cracks, twists, bends, or other injurious defects. Finishing shall be as produced by cold-drawing, cold-rolling, or machining.

The studs shall conform to the dimensions given in the following table:

Table 826-D

Shear Connector Studs

standard dimensions and tolerances in inches (millimeters)

Shank		*Head*	
Diameter (c)	*Length* (L)*	*Diameter (H)*	*Thickness (T)*
3/4 (19) +0.000 (+0.00) 0 (0) -0.015 (-0.5)	4+0.062 (100+1.6) -0.125 (-3.2)	1**3** + 1/64 (32 +0.5)	3/8 minimum (9.5 minimum)
7/8 (22) +0.000 (+0.00) 0 (0)	4+0.062 (100 +1.6) -0.125 (-3.2)	1 3/4 + 1/64 (44 +0.5)	3/8 minimum (9.5 minimum)

-0.015	(-0.5)			

* Length includes thickness of head. Standard length is 40 (100 mm) but other lengths may be obtained by special order.

The Contractor shall furnish the manufacturer's certification that the studs as delivered are in accordance with the material requirements of this Section. Certified copies of in-plant quality control test reports shall be furnished to the Engineer upon request.

It shall be the Contractor's responsibility to comply with all requests of the inspector to correct improper workmanship and to remove and replace, or correct as instructed, all welds found defective or deficient. The Department will inspect all welds using visual inspection or nondestructive testing.

826.05 Castings.

a. *Carbon Steel Forgings.* Steel forgings shall conform to AASHTO M 102, Class C, unless otherwise specified.
b. *Cold Finished Carbon Steel Shafting.* Cold finished carbon steel shafting shall conform to AASHTO M 169, Grade Designation 1016-1030, inclusive, unless otherwise specified.
c. *Alloy Steel Forgings.* Alloy steel forgings shall conform to AASHTO M 102, Class G, unless otherwise specified.
d. *Steel Castings for Highway Bridges.* Steel castings for use in highway bridge components shall conform to AASHTO M 192/M 192M, Class 70 (Class 485), Grade 70-36 (Grade 485-250) steel, or AASHTO M 103/M 103M.
e. *Chromium Alloy-Steel Castings.* Chromium alloy-steel castings shall conform to AASHTO M 163/M 163M, Grade CA-15, unless otherwise specified.
f. *Iron Casting.* Iron casting shall be gray-iron castings conforming to AASHTO M 105, Class No. 30, unless otherwise specified.
g. *Ductile Iron Castings.* Ductile iron castings shall conform to ASTM A 536, Grade 60-40-18, unless otherwise specified.
h. *Malleable Castings.* Malleable castings shall conform to ASTM A 47M, Grade No. 22010, unless otherwise specified.
i. *Workmanship, Finish, and Cleaning for Iron Castings, Ductile Iron Castings, and Malleable Castings.* Castings shall be true to pattern in form and dimensions, and free from pouring faults, sponginess, cracks, blow holes, or other defects in positions affecting their strength and value for the service intended.

   The castings shall be boldly filleted at angles. The arrises shall be sharp and perfect.

   All castings must be sandblasted or otherwise effectively cleaned of scale and sand to present a smooth, clean, and uniform surface.

j. *Bronze Castings.* Bronze castings shall conform to AASHTO M 107, Alloy UNS No. C91300 or C90500 modified with up to 2.5% lead maximum.

826.06 Bearing Materials.

a. *Elastomeric Bearing Pads.* The elastomeric bearing pads shall be cast in a single, integral layer. Multiple-layer pads, separated by non-elastic sheets to resist deformations in thick pads, may be permitted. The variation in thickness in the longitudinal direction (taper) shall not exceed 5% of the length of the pads. The least horizontal dimension of the pads shall not be less than five times the

thickness (shape factor l.25 minimum).

b. *Copper-Alloy Plates.* Copper-alloy plates shall conform to AASHTO M 108, Copper Alloy UNS No. C51000 or C65500.

c. *Polytetraflourethylene - Stainless Steel Structural Bearings.* The polytetrafluorethylene (TFE) self-lubricating bearing element shall be composed of 100% virgin (unfilled) TFE polymer, bonded to a rigid confining substrate. The substrate shall limit the flow (elongation) of the confined TFE to not more than 0.0090 (225 ìm) under a load of 2000 lb (14 MPa) for 15 minutes at 78 EF (26 EC) for a 2 by 30 (50 by 75 mm) test sample. The virgin (unfilled) TFE shall have a thickness of not less than 1/320 (1 mm). The properties of the TFE shall conform to the requirements of following table:

Table 826-E

TFE Properties

Requirements	*Test Method*	*Value*
Hardness at 78 EF (26 EC)	ASTM D 2240	50-65 Durometer D
Tensile Strength, psi (MPa)	ASTM D 1457	2800 (20) (min. avg.)
Elongation, %	ASTM D 1457	200 (min. avg.)
Deformation under load, % at 78E F (26 EC), 2000 psi (14 MPa) 1/2 x 1/2 x 1/32" (13 by 13 by 1 mm)	ASTM D 621	4 (max.)
Specific Gravity	ASTM D 792	2.14 to 2.21

The preformed fabric bearing pad shall consist of multiple layers of 8 oz (227 g) duck impregnated with high quality rubber, capable of withstanding loads of 10 ksi (70 MPa) perpendicular to the plane of lamination without detrimental reduction in thickness and without extrusion. Actual dimensions are determined by the design criteria noted on the structural drawings. The bearing pad shall meet the environmental requirements of MIL-STD-810E(2).

The stainless steel shall be no less than 16 gage (1.5 mm) meeting the AISI Type 304 (ASTM A 240) requirements and have a mirror finish of less than 10 microinches Root-Mean-Square (0.25 ìm) on the side in contact with the TFE. The stainless steel shall be 1/80 (3 mm) smaller than the sole plate all around. The stainless steel shall be mechanically bonded to the sole plate.

The coefficient of friction between the self lubricating bearing element (TFE) and the stainless steel shall not be more than 0.06 at 800 psi (5.6 MPa) compressive loading.

The sole plate and base plate shall be the same type of structural steel specified for the steel structure. The dimensions shall comply with the details as shown on the structural drawings. All exposed surfaces shall be given the coating specified for the steel structure. Unless otherwise specified, a base plate shall be used for each bearing.

The bearing pad shall have a shore "A" hardness of 90 " 5. The expansion bearing total thickness will be "10%. The TFE thickness shall be -0, + 0.0150 (-0, +0.4 mm).

d. *Steel - Bronze Bearings and Rocker Bearings.* The steel used for bearings shall be the same type of steel designated for the steel structure unless otherwise specified. All exposed surfaces, except sliding surfaces, shall receive the same coating used for the structural steel.

Steel surfaces of the sole plate, rocker plate, and web and bearing plates in contact with other surfaces, shall be machine finished to at least 250 microinches Root-Mean-Square (6.4 ìm). Surfaces of the sole plate and masonry plate in contact with the bronze plate shall have a machine finish of at least 125 microinches Root-Mean-Square (3.2 ìm). The sliding surfaces shall be coated with a multipurpose grease before shipment. Prior to erection, the coating shall be removed using a solvent.

The bearing shall be shop assembled and match-marked to ensure proper fit.

Bevel the sole plate to match the grade if the grade exceeds 1%. For low profile fixed bearings, bevel the sole plate if grade exceeds 3%.

Self-lubricating bronze bearing plates shall conform to the requirements of AASHTO M 107, Alloy C91100 unless otherwise specified. The sliding surfaces of the plates shall be polished and provided with annular grooves or cylindrical recesses, or a combination thereof, filled with a lubricating compound. The compound shall be free of any material that could cause abrasive or corrosive action upon the metal surfaces and also shall be able to withstand extremely high pressures and the atmospheric elements over long periods of time. The lubricating compound shall be compressed into the recesses under sufficient pressure to form a non-plastic, lubricating inset. The lubricating inset shall comprise not less than 25% of the total area of the plate. The frictional coefficient shall not exceed 0.10 during the first 1000 cycles at the design dead load.

e. *Elastomeric Bearings.* Elastomeric bearings shall conform to the AASHTO Standard Specifications for Highway Bridges, Section 18, Division II. The elastomer having a durometer hardness of 70 shall not be used in laminated bearings.

To prevent any relative movement between the bearing pad and the sole plate or the masonry, the Contractor shall perform one of the following:

1. Use epoxy and grit on the bottom surface of the sole plate and roughen the bridge seat, or

2. Use bonding compound approved by the Engineer to bond the contact surfaces. The beam and bearing pad shall be set in place before the bonding compound hardens.

The relative motion may be prevented using other methods recommended by the Contractor or the manufacturer, subject to the Engineer's approval.

826.07 Galvanizing. When galvanizing is shown on the Plans or specified in the Special Provisions, most ferrous metal products shall be galvanized in accordance with AASHTO M 111. High-strength bolts and other small, highly-stressed parts shall be mechanically galvanized as specified in Subsection 826.03.

826.08 Sheet Zinc. Sheet zinc shall conform to ASTM B 69, Type II.

SHOP FABRICATION.

826.09 Quality of Workmanship. Fabrication of primary load carrying members will require AISC Category I or III shop certification.

826.10 Connections Using High Strength Bolts. Connections using high-strength bolts shall conform to the requirements of Subsection 605.15.

826.11 Plate Cut Edges. Plate cut edges shall conform to the requirements of Subsection 605.16.

826.12 Welding and Oxygen Cutting. Temporary or permanent welds not shown on the Plans or permitted by this Section or Subsection 605.17 shall not be made without specific written authorization by the Engineer.

All welding and oxygen cutting shall conform to AWS D1.1 and ANSI/AASHTO/AWS D1.5.

Welding of steel structures and nondestructive testing of welds shall conform to ANSI/AASHTO/AWS D1.5. All nondestructive testing required shall be done by the Contractor in the presence of the DepartmentNs inspector.

1. *Welding Processes.* Manual shielded metal arc and submerged arc welding procedures covered in ANSI/AASHTO/AWS D1.5 are approved for use without procedure qualification tests.

   Vertical submerged arc, electrogas arc, and electroslag welding processes shall not be used unless called for in the Plans or Special Provisions. The Contractor may request permission to use these processes from the Engineer by written notification. The Engineer will make the final decision as to the suitability of such processes.

   The Engineer will not authorize the use of gas shielded, metal arc welding processes for welding of primary stress members (main girders, transverse beams, sign bridges, bridge bearings, etc.) or for any welded connections on either primary or secondary stress members. Consideration and authorization to use other welding processes may be given for welding of secondary stress members such as diagonal bracing to gusset plates, gusset plates to stiffeners, bridge railing posts, railing splices, grates, grate frames, and drain pipes.

   Processes outlined in ANSI/AASHTO/AWS D1.5 and authorized for use in fabrication shall conform to the applicable provisions of the Contract.
2. *Inspection of Welding.* The Contractor shall notify the Engineer at least 30 calendar days in advance of the beginning of work at the steel fabrication shop. The Engineer or the Engineer's authorized representative will be under no obligation to accept any shop work performed before the 30th day after such notice.

   Nondestructive inspection includes radiographic, magnetic particle, dye penetrant, and ultrasonic methods, as well as any other type of inspection the Contractor proposes to use with the EngineerNs approval.

   Edges of flange butt welds in tension areas shall be magnetic particle (yoke method) or dye penetrant tested.

   Ultrasonic testing may be used, when approved, in lieu of radiographic testing and shall be in accordance with AWS/AASHTO specifications.

   Nondestructive testing in addition to visual inspection shall be performed by the Contractor and shall be in compliance with the requirements of AWS D1.1 and as modified by ANSI/AASHTO/AWS D1.5.

   All inspections shall be performed by a firm or agent employing qualified welding inspection personnel and using equipment approved by the Department. The Contractor shall inform the DepartmentNs inspector (or the DepartmentNs inspection agency) of the name of its inspecting firm and the identity of the equipment to be used. No fabricated steel shall be inspected or accepted until the firm and its equipment have been approved.

   All radiographing, magnetic particle, ultrasonic and other nondestructive testing inspection shall be

performed in the presence of the Department's representative. All radiographing, magnetic particle, ultrasonic, and other nondestructive testing inspection performed without the Department's representative present will not be accepted and shall be repeated with the Department's representative present. The Contractor's inspector and the Department's representative shall jointly ascertain that each radiograph is photographically marked with a suitable identification indicating exactly where the image was taken on the beam or girder.

3. *Prequalification of Welding Operators.* All fabrication shop welders, welding operators, and tackers shall be qualified in accordance with AWS D1.1, as modified by ANSI/AASHTO/AWS D1.5. The Contractor shall ensure that the fabricator retains certified copies of the qualification test records (AWS D1.1, Appendix E) and requalification tests, if appropriate, for use by the Department's authorized representative upon demand. In addition, records shall be maintained by the Contractor to ensure compliance with AASHTO and AWS requirements for the period of effectiveness as indicated in AWS D1.1, Section 5.30.

826.13 Assembly.

a. *Shop Assembly.* The field connections of main members of trusses, arches, continuous beam spans, bents, towers (each face), plate girders, and rigid frames shall be assembled in the shop with milled ends of compression members in full bearing. While the connections are assembled the subsize holes shall be reamed to the specified size. Assembly shall be *Full Truss or Girder Assembly* unless *Progressive Truss or Girder Assembly*, *Full Chord Assembly*, *Progressive Chord Assembly*, or *Special Complete Structure Assembly* is specified in the Special Provisions or on the Plans.

A camber diagram shall be furnished to the Engineer by the Contractor showing the camber at each panel point of each truss, arch rib, continuous beam line, plate girder, or rigid frame. When the shop assembly is *Full Truss or Girder Assembly* or *Special Complete Structure Assembly*, the camber diagram shall show the camber measured during assembly. With any of the other methods of shop assembly, the camber diagram shall show the calculated camber.

Each assembly, including camber, alignment, accuracy of holes, and fit of milled joints, shall be approved by the Engineer before reaming is commenced.

b. *Full Truss or Girder Assembly.* This shall consist of assembling all members of each truss, arch rib, bent, tower face, continuous beam line, plate girder, or rigid frame at one time.

c. *Progressive Truss or Girder Assembly.* This shall consist of initially assembling for each truss, arch rib bent, tower face, continuous beam line, plate girder, or rigid frame at least three contiguous panels but not less than the number of panels associated with three contiguous chord lengths (i.e., length between field splices) and not less than 150' (45 m) in the case of structures longer than 150' (45 m). At least one shop section or panel or as many panels as are associated with a chord length shall be added at the advancing end of the assembly before any member is removed from the rearward end so that the assembled portion of the structure is never less than that specified above.

d. *Full Chord Assembly.* This shall consist of assembling, with geometric angles at the joints, the full length of each chord of each truss or open spandrel arch, or each leg of each bent or tower and then the reaming the field connection holes while the members are assembled and reaming the web member connections to steel templates set at the geometric (not cambered) angular relation to the chord lines.

Field connection holes in web members shall be reamed using steel templates. At least one end of each web member shall be milled or shall be scribed normal to the longitudinal axis of the member. The templates at both ends of the member shall be accurately located from one of the milled ends or scribed lines.

e. *Progressive Chord Assembly.* This shall consist of assembling contiguous chord members in the manner specified for *Full Chord Assembly* and in the number and length specified for *Progressive Truss or Girder Assembly*.
f. *Special Complete Structure Assembly.* This shall consist of assembling the entire structure including the floor system. This assembly is ordinarily needed only for complicated structures such as those having curved girders or extreme skews in combination with severe grades or cambers.

826.14 Match-Marking. Connecting members assembled in the shop for the purpose of reaming holes in field connections shall be match-marked. A diagram showing such marks shall be furnished to the Engineer.

826.15 Facing of Bearing Surfaces. The surface finish of bearing and base plates and other bearing surfaces that are to come in contact with each other or with concrete shall conform to the surface roughness requirements as defined in ANSI/ASME B46.1, Part 1, as follows:

Steel slabs	2000 microinches (50 Fm)
Heavy plates in contact in shoes to be welded	1000 microinches (25 Fm)
Milled ends of compression members, stiffeners, and fillers	500 microinches (12.5 Fm)
Bridge rollers and rockers	250 microinches (6.3 Fm)
Pins and pin holes	125 microinches (3.2 Fm)
Sliding bearings	125 microinches (3.2 Fm)

826.16 Fabrication of Members. Unless otherwise shown on the Plans, steel plates for main members and splice plates for flanges and main tension members shall be cut and fabricated so that the primary direction of rolling is parallel to the direction of the main tensile compressive stress.

826.17 Annealing and Stress Relieving. Structural members which are indicated in the Contract to be annealed or normalized shall have finish machining, boring, and straightening done subsequent to heat treatment. Normalizing and annealing (full annealing) shall be as specified in ASTM E 44. The temperatures during the heating and cooling process shall be maintained uniformly throughout the furnace so that the temperature at any two points on the member will not differ by more than 100 EF (56 EC) at any one time.

A record of each furnace charge identifying the pieces in the charge and showing the temperatures and schedule actually used shall be provided. Proper instruments, including recording pyrometers, shall be provided for determining the temperatures of members in the furnace at all times. The records of the treatment operation shall be available to and meet the approval of the Engineer.

Members such as bridge shoes, pedestals, or other parts that are built up by welding sections of plate together shall be stress relieved, when required by the Plans, this Section, or Special Provisions governing the Contract, in accordance with procedures established by ANSI/AASHTO/AWS D1.5.

826.18 Pins and Rollers. Pins and rollers shall be accurately turned to the dimensions shown on the drawings and shall be straight, smooth, and free from flaws.

Pins and rollers more than 90 (230 mm) in diameter shall be forged and annealed.

Pins and rollers 90 (230 mm) or less in diameter may be either forged and annealed, or fabricated from cold-finished, carbon-steel shafting.

In pins larger than 9" (230 mm) in diameter, a hole not less than 2" (50 mm) in diameter shall be forged full length along the axis after the forging has been allowed to cool to a temperature below the critical range under suitable conditions, to prevent injury by too rapid cooling, and before being annealed.

826.19 Boring Pin Holes. Pin holes shall be bored true to the specified diameter, smooth and straight, at right angles to the axis of the member and parallel with each other unless otherwise required. The final surface shall be produced by a finishing cut.

The distance outside to outside of end holes in tension members and inside to inside of end holes in compression members shall not vary from that specified more than 1/32" (1 mm).

826.20 Pin Clearances. The diameter of the pin hole shall not exceed that of the pin by more than 1/50" (0.5 mm) for pins 5" (125 mm) or less in diameter, or 1/32" (1 mm) for larger pins.

826.21 Threads for Bolts and Pins. Thread for all bolts and pins for structural steel construction shall conform to the Unified Standard Series UNC-ANSI B1.1, Class 2 A for external threads and Class 2 B for internal threads, except that pin ends having a diameter of 1 3/8" or more shall be threaded 6 threads to the inch. (Threads for all bolts for structural steel construction shall conform to ANSI/ASME B1.13M, Class 6H. Class 6G threads for pin ends having a diameter of 35 mm or more shall be threaded.)

826.22 Pilot and Driving Nuts. Two pilot nuts and two driving nuts for each size of pin shall be furnished, unless otherwise specified.

826.23 Notice of Beginning of Work. The Contractor shall give the Engineer 30 days notice prior to the beginning of work at the mill or in the shop so that inspection may be provided. The term "mill" means any rolling mill or foundry where material for the work is to be manufactured. No material shall be manufactured or work done in the shop before the Engineer has been so notified.

826.24 Facilities for Inspection. The Contractor shall furnish equipment, material, and work space for the inspection of material and workmanship in the mill and shop. The inspectors shall be allowed free access to the necessary areas of the mill and shop.

826.25 Identification of Steels During Fabrication. The Engineer shall be furnished with complete certified mill test reports showing chemical analysis and physical tests for each heat of steel for all members, unless excepted by the Engineer. Each piece of steel to be fabricated shall be properly identified for the Engineer.

Shop drawings shall specifically identify each piece that is made of steel. Pieces made of different grades of steel shall not be given the same assembling or erecting mark even though they are of identical dimensions and detail.

The Contractor's system of assembly marking individual pieces made of steel other than AASHTO M 183/M 183M steel and the issuance of cutting instructions to the shop (generally by cross-referencing the assembly marks shown on the shop drawings with the corresponding item covered on the mill purchase order) shall maintain the identity of the mill test report number.

The Contractor may furnish from stock any acceptable material that it can identify by heat number and mill test report.

During fabrication, up to the point of assembling members, each piece of steel other than AASHTO M 183/M 183M steel shall show clearly and legibly its specification identification color code shown in Table 826-F.

Individually marked pieces of steel that are used in the furnished size, or reduced from the furnished size only by end or edge trimming, in a manner that does not disturb the heat number or color, or leave any usable piece, may be used without further color coding provided that the heat number or color code remains legible.

Pieces of steel, other than AASHTO M 183/M 183M steel, that are to be cut to smaller size pieces shall, before cutting, be legibly marked with the AASHTO M 160/M 160M specification identification color code.

Individual pieces of steel, other than AASHTO M 183/M 183M steel, that are furnished in tagged lifts or bundles shall be marked with the AASHTO M 160/M 160 M specification identification color code immediately upon being removed from the bundle or lift.

Pieces of steel, other than AASHTO M 183/M 183M steel, that prior to assembling into members, will be subjected to fabricating operations such as blast cleaning, galvanizing, heating for forming, or painting, which might obliterate paint color marking, shall be marked for grade by low stress, steel die stamping, or by a substantial tag firmly attached.

The identification colors indicated in Table 826-F shall be used to mark materials meeting the individual specifications listed in Table 826-F.

Table 826-F

Identification Color Codes

AASHTO	*ASTM*	*Color*
M 244/M 244M	A 514/A 514M	Red
	A 517/A 517M	Red and Blue
M 223/M 223M	A 572/A 572M	Grade 345 Green and Yellow
M 222/M 222M	A 588/A 588M	Blue and Yellow

Other steels, except AASHTO M 183/M 183M steel, that are not covered in Table 826-F and are not included in the AASHTO M 160/M 160M specification shall have an individual color code established and recorded for the Engineer.

Upon request, the Contractor shall furnish an affidavit certifying that throughout the fabrication operation it has maintained the identification of steel in accordance with this Subsection.

826.26 Tests for Structural Members.

(a) *Full Size Tests.* When full size tests of fabricated structural members or eyebars are required by the Contract, the Contract will state the number and nature of the tests, the results to be attained, and the measurements of strength, deformation, or other parameters that are to be performed and recorded. The Contractor shall provide suitable facilities, material, supervision, and labor necessary for performing and recording the tests.

(b) *Non-Destructive Testing.* When non-destructive tests of fabricated structural members are required by the Contract, they shall be done in accordance with Subsection 826.12 (b).

826.27 Erection Marking and Shipping. Each member shall be painted or marked with an erection mark for identification. An erection diagram shall be furnished with erection marks shown thereon.

The Contractor shall furnish the Engineer with three copies of material orders, shipping statements, and erection diagrams as the Engineer may direct. The weights of the individual members shall be shown on the statements. Members weighing more than 3 tons (2.75 metric tons) shall have the weights marked thereon. Structural members shall be loaded on carriers, transported, and unloaded at their destination, without being excessively stressed, deformed, or otherwise damaged.

Bolts of one length and diameter, and loose nuts or washers of each size, shall be packed separately. Pins, small parts, and packages of bolts, washers, and nuts shall be shipped in boxed, crates, kegs, or barrels. The gross weight of any package shall not exceed 300 lb (135 kg). A list and description of the material enclosed shall be plainly marked on the outside of each shipping container.

SHOP PAINTING.

826.28 Urethane Paint System. The Contractor shall select a complete coating system from one manufacturer conforming to the requirements of Subsection 820.02 (a). This selected coating system must be submitted to the Department's Materials and Research Section for approval prior to coating.

The topcoat color of the structural steel shall match color chip No. 24172 (green) of FED-STD-595B, unless otherwise indicated on the Plans. The Contractor shall supply the Engineer with the product data sheets before any painting is done. The product data sheets shall indicate the mixing and thinning directions, the recommended spray nozzles and pressures and all other coating related information.

826.29 General Requirements. Shop painting of metal structures shall consist of shop cleaning, and shop application of the coating system on new structural steel and fasteners with the provision for field application of the topcoat at the option of the Contractor. Included is the cleaning and repair of surfaces damaged in shipping, handling, and erecting the structural steel in accordance with this Specification and as directed by the Engineer.

The coating system shall consist of a coat of inorganic zinc-rich primer, a coat of high-build epoxy, and a urethane topcoat. Terminology used herein is in accordance with the definitions used in Volume 2, Systems and Specifications of the SSPC Steel Structures Painting Manual.

With the exception of abutting joints and base plates, machine finished surfaces shall be painted as soon as practicable after being accepted, and before removal from the shop, with a layer of material meeting the requirements of MIL-C-16173E, automotive grease, or other approved corrosion preventing material.

All structural steel painting will be performed in the shop, except the final coat (topcoat) may be applied in the field after erection. There will be no separate payment for any additional costs of any kind associated with field painting.

826.30 Provisions for Inspection. During fabrication and shop coating, scaffolding shall be furnished and erected, meeting the approval of the Engineer to permit inspection of the steel prior to and after coating.

Rubber rollers, or other protective devices meeting the approval of the Engineer shall be used on scaffold fastenings. Metal rollers or clamps and other types of fastenings which will mar or damage freshly coated surfaces shall not be used.

826.31 Preparation for Shop Coating. All areas shall be blast cleaned to a near-white finish as defined in SSPC-SP 10 for which reference should be made to SSPC Visual Standards. Areas of oil and grease on

surfaces to be coated shall be cleaned with clean petroleum solvents prior to blast cleaning. Prior to blast cleaning a beam, the top of the bottom flange shall be scraped to remove any accumulated dirt.

All fins, tears, slivers, and burred or sharp edges that are present on any steel member, or that appear during the blasting operations, shall be removed by grinding and the area re-blasted to give a 1 to 2**2** mil (25 to 63 ìm) surface profile. Scaling hammers may be used to remove heavy scale, but heavier type chipping hammers which would excessively scar the metal shall not be used.

The abrasive used for blast cleaning shall be in accordance with Subsection 605.45, and shall have a gradation such that the abrasive will produce a uniform profile of 1 to 2**2** mil (25 to 63 ìm), as measured with Testex Replica Tape.

All abrasive and paint residue shall be removed from steel surfaces with a good commercial grade vacuum cleaner equipped with a brush-type cleaning tool, or by double blowing. If the double blowing method is used, the exposed top surfaces of all structural steel, including flanges, longitudinal stiffeners, splice plates, hangers, etc., shall be vacuumed after the double blowing operations are completed. The air line used for blowing the steel clean shall have an in-line water trap and the air shall be free of oil and water as it leaves the air line. The steel shall then be kept dust free, and primed within eight hours after blast cleaning.

Care shall be taken to protect freshly coated surfaces from subsequent blast cleaning operations. Blast damaged primed surfaces shall be thoroughly wire brushed or, if visible rust occurs, re-blasted to a near-white condition. The wire brushed or blast cleaned surfaces shall be vacuumed and re-primed.

All areas where field welding is required, shall be masked prior to applying the primer. Areas where shear stud connectors will be welded to the top flange shall be masked after the primer coat has been applied, but before the epoxy coat is applied.

826.32 Painting Conference. Before fabrication of the structural steel begins the appropriate parties involved shall attend a "Post-Award Painting Conference".

Present at the conference shall be the following:

a. Contractor.
b. Steel fabricator and its coating specialist.
c. Paint and coating material supplier including local technical and sales representative plus any other experienced personnel.
d. Engineer.

The purpose of the conference is to discuss the specifications in detail and ensure that the painting work conforms to the manufacturerÑs product data sheets and application instructions as well as the requirements of this Section.

The discussions shall include:

a. Equipment use and servicing.
b. Material storage.
c. Application techniques (including thickness tolerances).
d. Definition of the degree of cleaning, i.e., SSPC Pictorial Standards.
e. Surface preparation of shop-primed surfaces by shotblasting or sandblasting, describing abrasive to be used, necessary air pressure at the blast nozzle, etc.
f. Inspection requirements including surface preparation, wet and dry film thickness checking, techniques, and equipment to be used.

g. Inspection Reports.
h. Safety precautions stated in the manufacturer's printed instructions.Availability of the work for inspection by the Engineer.

826.33 Painting.

a. *Mixing the Paint.* The paint shall be mixed with a high shear mixer such as Jiffy Mixer, in accordance with the manufacturerNs directions, to a smooth, lump-free consistency. Paddle mixers or paint shakers are not allowed. Mixing shall be done thoroughly, in the original containers, and shall be continued until all the metallic powder or pigment are in suspension.

Care shall be taken to ensure that all of the paint solids that may have settled to the bottom of the container are thoroughly dispersed. The paint shall then be strained through a screen having openings no larger than those specified for a No. 50 (300 Fm) sieve in AASHTO M 92. After straining, the mixed paint shall be kept under continuous agitation up to and during the time of application.

b. *Thinning the Paint.* In general the paints are supplied for normal use without thinning. If it is necessary to thin the paint for proper application in cool weather, or to obtain better coverage of the urethane topcoat, the thinning shall be done in accordance with the manufacturer's recommendations and shall be subject to the Department's approval.

c. *Conditions for Painting.* Paint shall be applied only when the following conditions have been met:

1. *Temperature.* The temperature of the air and the steel shall be above 50 ºF (10 ºC) for paint other than the topcoat. This 50 ºF (10 ºC) minimum temperature shall be maintained throughout the minimum time between coats as listed in the Qualified Products List. For the urethane topcoat, the temperature of the air and steel shall be above 40 ºF (4 ºC). Coatings shall not be applied if the temperature is high enough to cause blistering. The surface temperature of the steel shall be at least 5 ºF (3 ºC) higher than the dew point.
2. *Humidity.* The paint shall not be applied when the relative humidity is greater than 90%, nor when a combination of temperature and humidity conditions are such that moisture condenses on the surface being painted.

d. *Applying the Paint.* After the surface to be coated has been cleaned and approved by the Engineer, the primer shall be applied so as to produce a uniform even coating bonded with the metal. Succeeding coats shall be applied when approved by the Engineer. The minimum curing time between coats shall be according to the manufacturerNs specifications. Depending on site conditions, additional time may be required for proper curing before applying succeeding coats. Cure time for proper application of succeeding coats shall not be less than the minimum nor exceed the maximum as recommended by the paint manufacturer. The Contractor shall provide the Engineer written documentation of manufacturer recommended cure times and any pre-treatments of existing coats prior to application of succeeding coats. It is the applicatorNs responsibility to determine the condition of each coat prior to application of succeeding coats. Any oxidation products, chalking, salts, residue or other surface condition that form on existing paint surfaces and interfere with proper adhesion shall be completely removed in accordance with manufacturer recommendations or as directed by the Engineer. Removal shall be accomplished through water blasting, solvent wiping, brush-off blasting or other means as necessary to properly prepare the surface for coating.

The coatings shall be applied with the spray nozzles and pressures recommended by the producer of the coating system, so as to attain the film thicknesses specified. All surfaces, including faying (contact) surfaces, and flange tops, shall be shop primed by spray in accordance with SSPC-PA 1. The intermediate coat shall also be applied in the shop in accordance with SSPC-PA 1. The topcoat

shall be shop applied or field applied after steel erection at the Contractor's option. Faying surfaces and surfaces to be in contact with Portland cement concrete shall not receive the intermediate and topcoats.

Flange tops shall receive a fog coat of between **2** and 3/4 mils (12 and 19 ìm) of inorganic zinc primer. The dry film thickness of the primer coat on the bolted friction splices on the main members shall not be less than 1 mil (25 ìm) or greater than 2**2** mils (63 ìm). The faying surfaces of bolted field splices, bolted shop splices, or any other bolted faying surfaces, shall be masked during subsequent coating operations. In the areas of field bolted connections (including the outside surface of splice plates), the outside surfaces shall be primed a minimum of 4 mils (100 ìm). On all other areas, the minimum dry film thickness for the primer coat shall also be 4 mils (100 ìm), for the epoxy coat it shall be 3**2** mils (88 ìm), and for the urethane protective coat it shall be sufficient to provide a uniform color and appearance but in no case shall be less than 1 mil (25 ìm).

The dry film thickness will be determined by the use of a magnetic dry film thickness gage. The gage shall be calibrated on the blasted steel with plastic shims approximately the same thickness as the minimum dry film thickness. A Tooke film thickness gage may be used to verify the coating thickness when requested by the Engineer. If the Tooke gage shows the primer coat to be less than the specified minimum thickness, the total coating system will be rejected even if the total dry film thickness exceeds the total of the minimum for each coat of the three-coat system.

All bolted shop connections and shop bolted cross frames or diaphragms shall be removed and disassembled prior to the blasting and coating of the girders or beams. The parts shall be blasted separately, primed, then reassembled and the bolts fully tightened in accordance with the applicable specifications.

All galvanized components in bolted shop connections, including mechanically galvanized nuts, bolts, and washers, shall be solvent cleaned, given a tie coat, if recommended by the paint manufacturer, and then coated with both the epoxy coat and the urethane protective coat.

If the application of the coating at the required thickness in one coat produces runs, bubbles, or sags, the coating shall be removed and reapplied in multiple passes of the spray gun, the passes separated by several minutes. Where excessive coating thickness produces "mud-cracking", such coating shall be scraped back to soundly bonded coating and the area recoated to the required thickness.

In areas of deficient primer thickness, the areas shall be thoroughly cleaned with power washing equipment, as necessary, to remove all dirt; the areas shall then be wire brushed, vacuumed, and recoated.

All coating shall be done in a neat and workmanlike manner as described in SSPC-PA 1, producing a uniform, even coating which is bonded to the underlying surface.

Erection marks, for the field identification of members, and weight marks shall be transferred or preserved.

All metal coated with impure, unsatisfactory, or unauthorized coating material, or coated in an unworkmanlike or objectionable manner, shall be thoroughly cleaned and recoated or otherwise corrected as directed by the Engineer.

All dry spray shall be removed, by sanding if necessary, prior to the application of the succeeding coat.

Material shall not be loaded for shipment until the shop coating has been adequately cured and

inspected. The components will be stamped "Recommended for Use" only after the loading has been completed and approved.

826.34 Stenciling Requirement. At the completion of the painting work, the completion date (month and year) and the bridge number, shall be stenciled on the structure in 3Ø (75 mm) numbers. The paint used for this marking shall be the same as the topcoat except the color shall be black. The numbers shall be stenciled on the outside of each fascia beam at the approaching traffic end of the structure, on a location designated by the Engineer.

826.35 Handling Steel. Extreme care shall be exercised in handling the steel in the shop, during shipping, during erection, and during subsequent construction of the bridge. The steel shall be insulated from the binding chains by softeners approved by the Engineer. Hooks and slings used to hoist steel shall be padded. Diaphragms and similar pieces shall be spaced in such a way that no rubbing will occur during shipment that may damage the coatings. The steel shall be stored on pallets at the job site, or by other means approved by the Engineer, so that it does not rest on the dirt or so that components do not fall or rest on each other. All shipping and job site storage details shall be presented to the Engineer at the "Post-Award Painting Conference" and they must be approved prior to shipping the steel.

826.36 Field Repair and Field Coating. The Contractor shall furnish and erect scaffolding meeting the approval of the Engineer and shall provide a time mutually agreed upon for inspecting the structural steel prior to and after coating.

Rubber rollers, or other protective devices meeting the approval of the Engineer, shall be used on scaffold fastenings. Metal rollers or clamps and other types of fastenings which will mar or damage freshly coated surfaces shall not be used.

All field repairs shall be made in strict accordance with the coating supplierÑs recommendations and shall be approved by the Engineer. All coatings applied to repair areas shall be applied using recommended spray equipment only. The coating supplierÑs recommendations are to be supplied to the field personnel by the fabricator of the steel. Such field repairs shall include the application of the following coating system; e.g., on rusted areas: the zinc-rich primer, the epoxy intermediate coat, and the urethane protective coat; on non-rusted areas (where the primer is at least equal to the minimum required dry film thickness): the epoxy intermediate coat and the urethane protective coat; and on galvanized components: the tie coat, the epoxy intermediate coat, and the urethane protective coat.

Surfaces which will be inaccessible for coating after erection shall be repaired and/or recoated prior to erection.

When the erection work has been completed, including all connections and the straightening of any bent metal, the steel shall be prepared for repairs. All adhering scale, dirt, grease, form oil, or other foreign matter shall be removed by appropriate means and any rusted or uncoated areas blast cleaned to a near-white finish in accordance with SSPC-SP 10. All abrasive and paint residue shall be removed from steel surfaces by vacuuming or by double blowing, except that if the double blowing method is used, the top surfaces of all structural steel, including top and bottom flange, splice plates, hangers, etc., shall be vacuumed after the double blowing operations are completed. The coating surrounding the blasted area shall be thoroughly wire brushed, vacuumed, and the area recoated with the same coating system used in the shop. When spraying a blasted area or an area of insufficient primer thickness, the surrounding area will be coated with primer. Prior to the application of the intermediate coat, the area around the area where the primer has been repaired shall be adequately rubbed to remove the primer from the surrounding epoxy or urethane. The requirements specified herein for provisions for inspection, mixing the coating, thinning the coating, temperature, and humidity requirements for coating, and applying the coatings, shall govern application of the topcoat and application of the coating to the repaired areas. The requirements for the dry film thickness of the topcoat

and the repair coats are the same as for the shop coats. Proper curing conditions will be required prior to application of the topcoat and between applications of the repair coats as previously specified herein.

Mechanically galvanized nuts, bolts, and washers shall be coated in accordance with the recommendations of the manufacturer of the coating system. This procedure shall include the removal of any lubricant or residuals on the surface and the application of a tie coat prior to application of the field coats. This tie coat shall be brushed or sprayed as specified by the manufacturer. The epoxy and urethane shall then be applied to the bolts and the surrounding connection surfaces.

Any temporary attachments or supports for scaffolding or forms shall not damage the coating system. (In particular, on the fascias where bracing is used, sufficient size support pads must be used.) Any damage that occurs from such devices shall be repaired by the same procedure as for a field repair.

If the stenciling which was applied at the completion of the shop coating is marred or damaged, the marking shall be repaired as directed by the Engineer. The paint used for this marking repair shall be the same as the urethane protective coat used in the field repairs except the color shall be black.

826.37 Protection of the Work. Pedestrian, vehicular, and other traffic upon or underneath the structure shall be protected in accordance with Section 107. All portions of the structures (superstructure, substructure, slope protection and highway appurtenances) shall be protected against splatter, overspray splashes, and smirches of coating or coating material by means of protective covering suitable for the purpose. The Contractor shall be responsible for any damage caused by his operations to vehicles, persons or property.

Whenever the intended purposes of the protective devices are not being accomplished, work shall be suspended until corrections are made.